



■ Documentation for:

**IRELAND INDUSTRIES
SEVERANCE CORNERS MIXED
USE DEVELOPMENT**

Colchester, Vermont

■ Prepared for:

Ireland Industries

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IRELAND INDUSTRIES' SEVERANCE CORNERS MIXED-USE DEVELOPMENT

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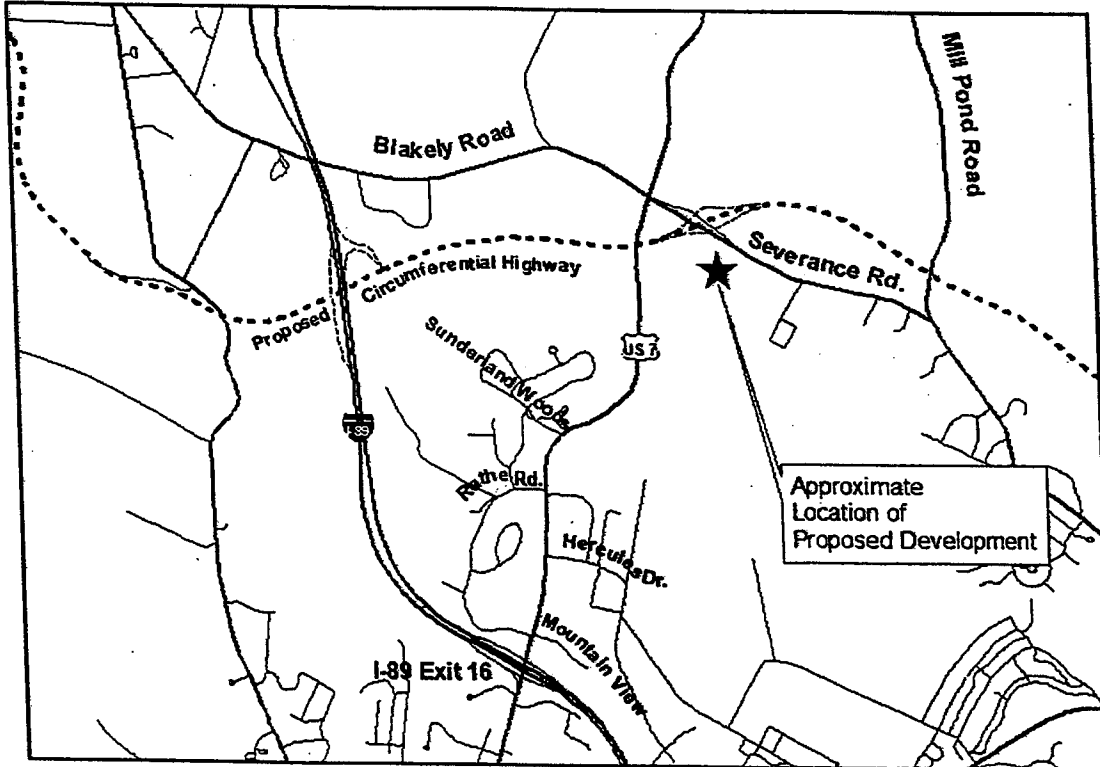
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1.0 INTRODUCTION

A residential and commercial mixed-use development has been proposed for the southeast corner of the US 7-Severance Road-Blakely Road intersection in Colchester, Vermont, as shown in Figure 1.

Figure 1: Location of Proposed Development



A traffic impact study was first completed for this project in June 2001. Since that time, the design has been revised with fewer housing units and less commercial space. This traffic study of the proposed revised development includes:

- The number of estimated new vehicle trips due to the proposed development;
- The turning movements at the study area intersections and site driveways for scenarios with and without the proposed development;
- Projected levels of service at the study intersections for all scenarios; and
- A safety review of the study area.



This study relies upon design standards and analysis procedures documented in the 2000 *Highway Capacity Manual*,¹ *Trip Generation Handbook*,² *A Policy on Geometric Design of Highways and Streets*,³ *Manual on Uniform Traffic Control Devices (MUTCD)*,⁴ *Traffic Impact Evaluation: Study and Review Guide*,⁵ and the *Vermont State Design Standards*.⁶

2.0 PROJECT AND SITE DESCRIPTION

The proposed project includes the land uses listed in Table 1. When complete, the project will consist of 206 housing units and 54,540 square feet of commercial space.

Table 1: Project Description

Land Use	Description and Size
Sit-Down Restaurant	4,050 Sq. Feet
Condos/Townhouses	206 Units
General Retail	12,400 Sq. Feet
Office	34,040 Sq. Feet
Day Care	4,050 Sq. Feet

The project will access Severance Road at two points. The western entrance will be located approximately 1,680 feet east of US 2/7. As shown in Figure 1, a future interchange between the proposed Chittenden County Circumferential Highway and Severance Road is located between US 7 and the proposed development. The western entrance of the development is located approximately 480 feet east of the nearest future Circumferential Highway ramp junction with Severance Road. The western entrance will be configured such that only right turns in and out will be permitted. No auxiliary turn lanes will be provided on Severance Road at this entrance. The right-turn northbound approach will be controlled by a stop sign.

The eastern entrance will be located 420 feet east of the western entrance. All turning movements in and out are permitted at this location. The northbound approach from the proposed development

¹ Transportation Research Board, National Research Council, *Highway Capacity Manual: Special Report 209*, Washington DC, 2000.

² Institute of Transportation Engineers, *Trip Generation Handbook*, Seventh Edition, Washington DC, March 2001.

³ American Association of State Highway and Transportation Officials (AASHTO), *A Policy on Geometric Design of Highways and Streets*, 4th Edition. Washington DC, 2001.

⁴ American Traffic Safety Services Association (ATSSA), ITE, and AASHTO, *Manual on Uniform Traffic Control Devices*, Millennium Edition, 2001.

⁵ VAOT, Planning & Traffic Research Division, *Traffic Impact Evaluation: Study and Review Guide*. January 2003.

⁶ VAOT, *Vermont State Standards for Design of Transportation Construction, Reconstruction, Rehabilitation on Freeways, Roads, and Streets*, July 1997.



will include an exclusive left turn lane and an exclusive right turn lane. The approach will be controlled by a stop sign.

2.1 STUDY AREA ROAD NETWORK

The major highways in the study area are US 2/7, Severance Road, and Blakely Road. US 2/7 is classified as a principal arterial and is owned and maintained by the State of Vermont. The cross section of US 2/7 varies from two through lanes in each direction between I-89 and Rathe Road to one through lane in each direction north of Rathe Road. Additional turn lanes are provided at most of the major intersections.

Severance and Blakely Roads are classified as collector roads. They are each class 2 town highways and are therefore owned and maintained by the Town of Colchester. The cross section of Severance and Blakely Roads includes one 11-foot wide through lane in each direction with 3 foot shoulders. Each road is also identified as a bike route.

Table 2 lists the average annual daily traffic volumes on US 2/7, Severance Road and Blakely Road in the study area. Traffic volumes are highest on US 2/7 south of its intersection with Blakely and Severance Roads. The decrease in traffic volumes north of the Blakely and Severance Roads on US 2/7 occurs because the intersection disperses traffic to and from the town highway road system at this location.

Table 2: Average Annual Daily Traffic in the Study Area

Location	Count Station	Most Recent Count Available	Average Annual Daily Traffic (Vehicles per Day)
US 2/7 south of Severance/Blakely Roads ¹	D040	2004	14,500
US 2/7 north of Severance/Blakely Roads ¹	D049	2004	10,300
Severance Road, 0.4 miles east of US 2/7 ¹	D519	2003	8,800
Blakely Road, west of US 2/7 ²	D407	2003	9,800

¹ Counts conducted by the Vermont Agency of Transportation.

² Counts conducted by the Chittenden County Metropolitan Planning Organization

Table 3 lists the posted speed limits along US 2/7, Blakely Road, and Severance Road. Posted speed limits vary along US 2/7 from 30 mph to 50 mph. Advisory speed limits of 40 mph (reduced from 50 mph) are posted on the US 2/7 northbound and southbound approaches to the Severance Road/Blakely Road intersection and on the southbound approach to the Sunderland Woods intersection.

Table 3: Study Area Posted Speed Limits

Location	Posted Speed Limit
US 2/7 – I-89 Exit 16 to Mountain View Drive	30 mph
US 2/7 – Mountain View Drive to Rathe Road	40 mph
US 2/7 – Rathe Road to north of Severance and Blakely Road Intersection	50 mph
Severance Road	35 mph
Blakely Road	35 mph



3.0 SCOPE OF STUDY

3.1 TRAFFIC SCENARIOS

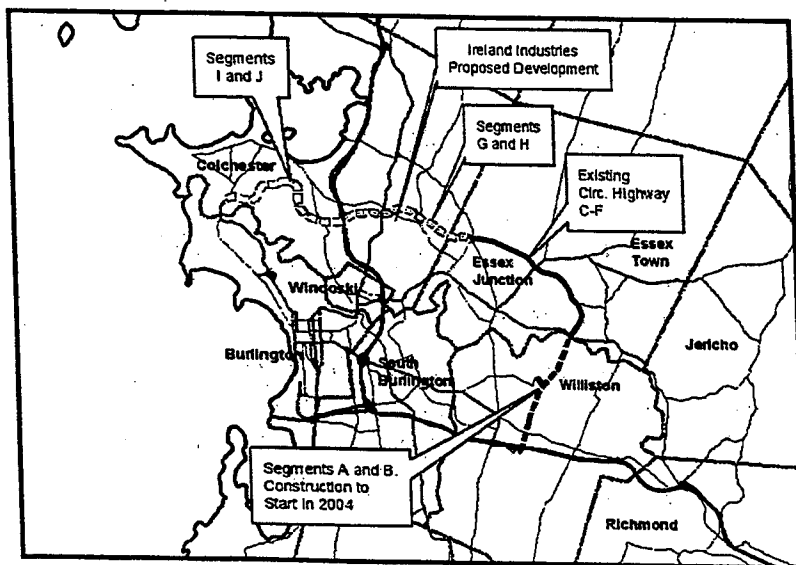
Traffic analyses have been conducted for 2007 and 2012 during the AM and PM peak hours as follows:

1. 2007 No Build;
2. 2007 Build;
3. 2012 No Build; and
4. 2012 Build.

All No Build scenarios include traffic from other permitted developments as described below in Section 4.2. All Build scenarios assume complete build-out of the proposed project

The 2007 scenarios assume no changes to the highway network. The 2012 scenarios assume completion of Segments A and B of the Chittenden County Circumferential Highway as indicated in Figure 2. The other un-built sections of the Circumferential Highway, (Segments G, H, I, and J) are not included in the 2012 analysis.

Figure 2: Circumferential Highway Segments



3.2 INTERSECTIONS TO ANALYZE FOR CONGESTION

Figure 3 shows the location of the twelve study intersections.

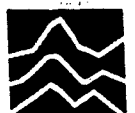


Figure 3: Study Intersections

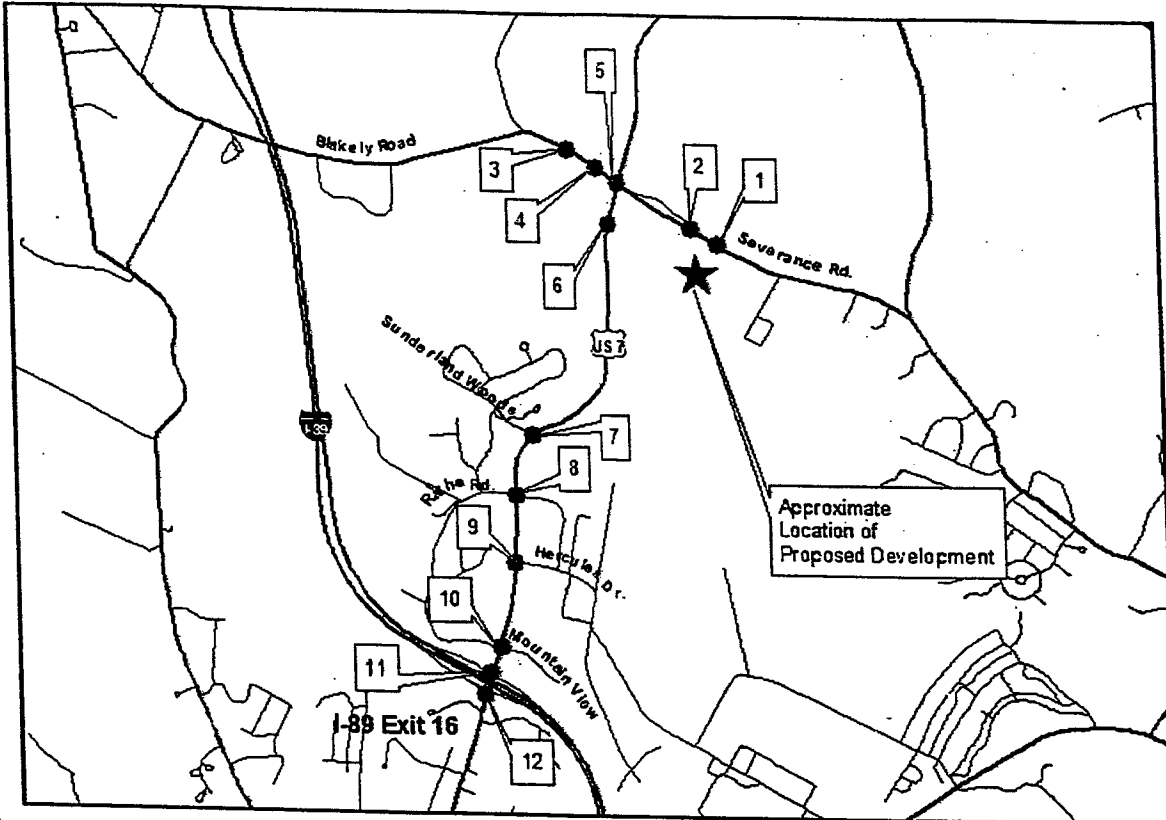


Table 4 describes whether or not the intersection is controlled by a stop sign or traffic signal. As required in the VTrans' *Traffic Impact Evaluation Study and Review Guide*, the geographic scope of a traffic impact study normally includes those intersections or highway segments receiving 75 or more project generated peak hour trips, as well as the immediate access points. Had that rule been applied, only the Ireland site driveways and the US 2/7 intersection with Severance and Blakely Roads would have been included. At the request of the Town of Colchester, the additional intersections have been included. These include future intersections between access points for the Severance Corners Village Center Development in the southwest quadrant of Severance Corners and Blakely Road and US 2/7 (Intersections number 3, 4, and 6 in Figure 3).



Table 4: Study Intersections

Map ID	Intersection Name	Control Type
1	Severance Road with Ireland East Drive	Stop Sign
2	Severance Road with Ireland West Drive	Stop Sign
3	Blakely Road with Kolok West Driveway	Stop Sign
4	Blakely Road with Kolok East Driveway	Stop Sign
5	US 2/7 with Severance & Blakely Roads	Traffic Signal
6	US 2/7 with Kolok South Driveway	Stop Sign
7	US 2/7 with Sunderland Woods	Traffic Signal
8	US 2/7 with Rathe Road and Champlain Drive	Traffic Signal
9	US 2/7 with Hercules Drive	Traffic Signal
10	US 2/7 with Mountain View Drive	Traffic Signal
11	US 2/7 with I-89 Exit 16 Northbound Ramps	Traffic Signal
12	US 2/7 with I-89 Exit 16 Southbound Ramps	Traffic Signal

4.0 EXISTING & FUTURE TRAFFIC VOLUMES

4.1 BACKGROUND TRAFFIC VOLUMES

AM and PM peak hour traffic volumes at the study intersections are based on traffic counts conducted at the study intersections on the dates shown in Table 5. The raw traffic counts are adjusted in two ways.

First, the AM and PM turning movement counts are adjusted to reflect the design hour volume (DHV) of traffic. The DHV is the 30th highest hour of traffic for the year and is used as the design standard in Vermont. All design hour adjustments employ data from Continuous Traffic Counter (CTC) D040, located on US 7 in Colchester between Sunderland Woods and the Severance/Blakely Road intersection. This counter records traffic volumes twenty-four hours per day, 365 days per year and therefore, provides a comprehensive picture of how traffic volumes vary throughout the year in the study area.

Table 5: Intersection Turning Movement Counts

Study Intersections	AM Peak		PM Peak	
	Date	Day of Week	Date	Day of Week
US 2/7-Severance Rd-Blakely Rd*	6/4/2004	Friday	6/4/2004	Friday
US 2/7-Sunderland Woods Rd	N/A	N/A	8/21/2001	Tuesday
US 2/7-Rathe Rd	5/25/2003	Wednesday	5/28/2003	Wednesday
US 2/7-Hercules Dr	5/28/2003	Wednesday	5/28/2003	Wednesday
US 2/7-Lower Mountain View Dr	5/28/2003	Wednesday	5/28/2003	Wednesday
US 2/7-I-89 NB Ramps	5/28/2003	Wednesday	5/28/2003	Wednesday
US 2/7-I-89 SB Ramps	5/28/2003	Wednesday	5/28/2003	Wednesday

* Count performed by the Chittenden County Metropolitan Planning Organization. All other counts performed by VTrans.



The second adjustment accounts for increases in background traffic stemming from general regional growth between the year the count was conducted and the study years. These background growth factors are also based on VTrans CTC station D040. The most recent count data available for station D040 is through the year 2004. Intersection counts conducted prior to 2004 are adjusted to 2004 based on actual growth in the average annual daily traffic volumes measured at station D040 (see Table 6). As indicated in Table 6, traffic volumes have fluctuated on US 7 between 2000 and 2004. Adjustments from the base count to 2007 and 2012 were made using the long term growth factors developed by VTrans for station D040 as documented in the 2004 *Red Book*. The growth factors developed by VTrans indicate a projected average annual growth in traffic of 1.6% per year. The total annual growth factors applied to the intersections are shown in Table 7.

Table 6: AADT at Station D040 Located on US 7 in Colchester from 2001 to 2004

Year	AADT
2001	14100
2002	14200
2003	14100
2004	14500

Table 7: Growth Factors

From	To	
	2007	2012
2001	1.08	1.17
2002	1.07	1.16
2003	1.08	1.17
2004	1.05	1.14

Appendix A shows the raw traffic count data, adjustments to design hour volumes, and background growth factors to 2007 and 2012 for each study intersection.

4.2 TRAFFIC FROM OTHER PERMITTED DEVELOPMENTS

All No Build scenarios include the estimated background traffic volumes and traffic generated from the Severance Corners Village Center project (formally referred to as the Kolok project) proposed for the southwest quadrant of Severance Corners. The Severance Corners Village Center project received its Act 250 approval and is currently pending construction. The development includes 86,100 square feet of mixed office, commercial, retail and restaurant and 152 residential units. This development adds an estimated 231 AM peak hour vehicle trips (138 inbound and 93 outbound) and 309 PM peak hour vehicle trips (132 inbound and 177 outbound) to the road network. We have included all of these additional trips during the 2007 and 2012 scenarios.



4.3 EFFECT OF THE CIRCUMFERENTIAL HIGHWAY

The 1998 Chittenden County Transportation Model is used to estimate the effect of Segments A and B of the Circumferential Highway on both background traffic volumes at the study intersections and the route followed to and from the Severance Corners Village Center and Ireland Industries development. The regional transportation model is maintained by the Chittenden County Metropolitan Planning Organization (CCMPO) and estimates both AM and PM peak hour traffic along road segments and through intersections.

Intersection turning movements were estimated using the model for the following conditions:

1. Existing Circumferential Highway segments (C-F) only; and
2. Existing Circumferential Highway segments (C-F) plus Segments A and B.

Using output from the model, a ratio was developed for each turning movement of the study intersections that reflects the effect of adding the Segments A and B of the Circumferential Highway. The ratio is equal to the model estimated turning movement volume assuming completion of Segments A and B, divided by the model estimated turning movement volume assuming only the existing segments C-F of the Circumferential Highway. The factor is then applied to the 2012 estimated DHV for the AM and PM peak hours to create 2012 background intersection volumes that account for the effect of the Circumferential Highway. Appendix A shows the adjustments made to background traffic volumes to account for the Segments A and B of the Circumferential Highway.

The transportation model was also used to estimate how vehicle trips to and from the two developments would change as different segments of the Circumferential Highway are completed. For the purposes of the transportation model, the County has been divided into 325 transportation analysis zones (TAZs). Each TAZ includes a number of households and employees. The model estimates the number of vehicle trips generated by and between the TAZs. Vehicle trips are then assigned to the highway network by selecting the shortest path between a trip's origin and destination. The TAZ structure was refined around Severance Corners to create separate TAZs for each quadrant allowing the Severance Village development to be separated from the Ireland development. Using the model's select zone utility, the route followed to and from the TAZ with the proposed Severance Village development, and how it changes with different segments of the Circumferential Highway, was identified.

Appendix A shows the distribution of vehicle trips for all scenarios.

Figure 4 and Figure 5 show the 2007 AM and PM No Build Traffic Volumes and Figure 6 and Figure 7 show the 2012 AM and PM No Build Traffic Volumes.



Figure 4: 2007 AM No Build Traffic Volumes

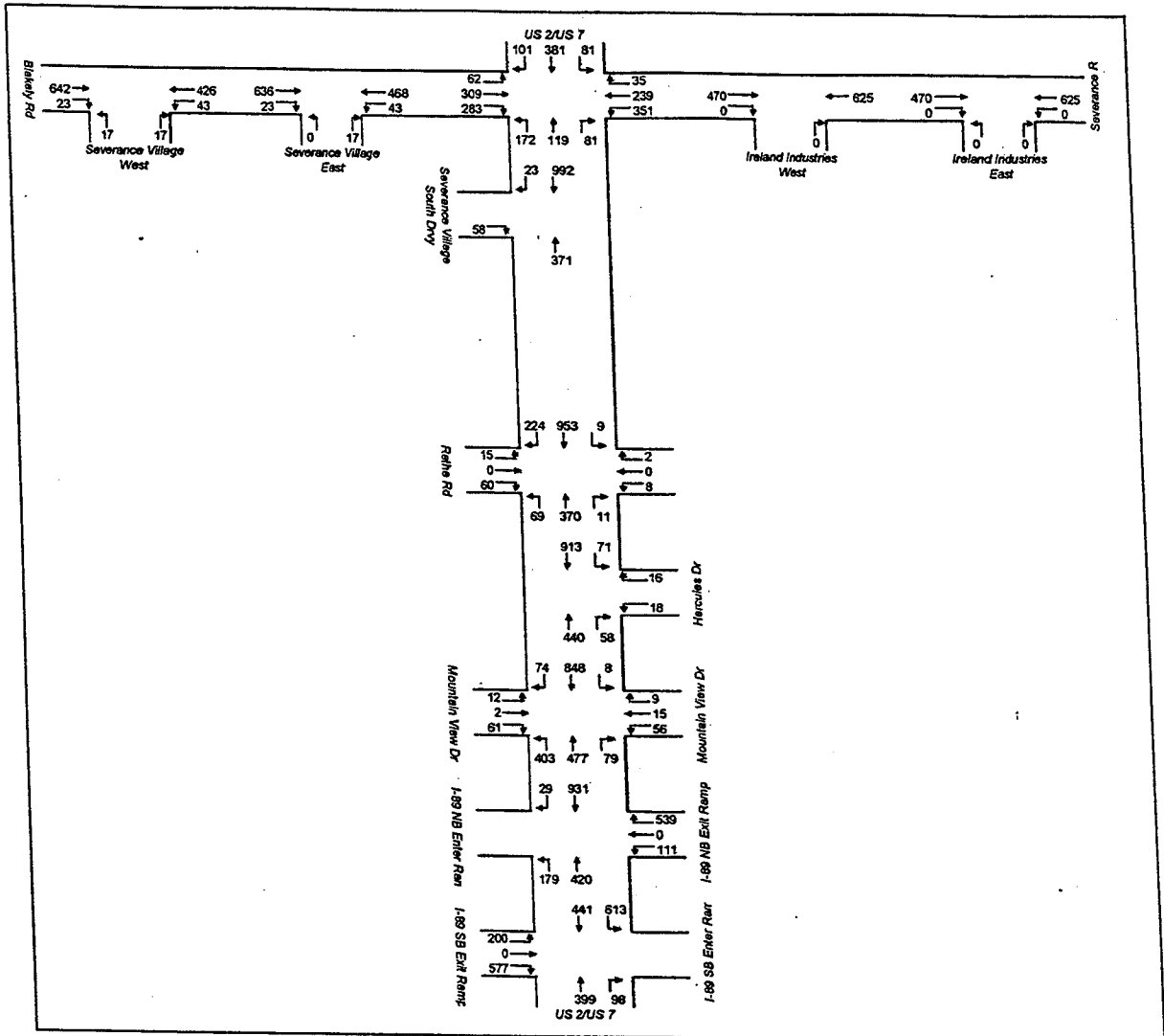
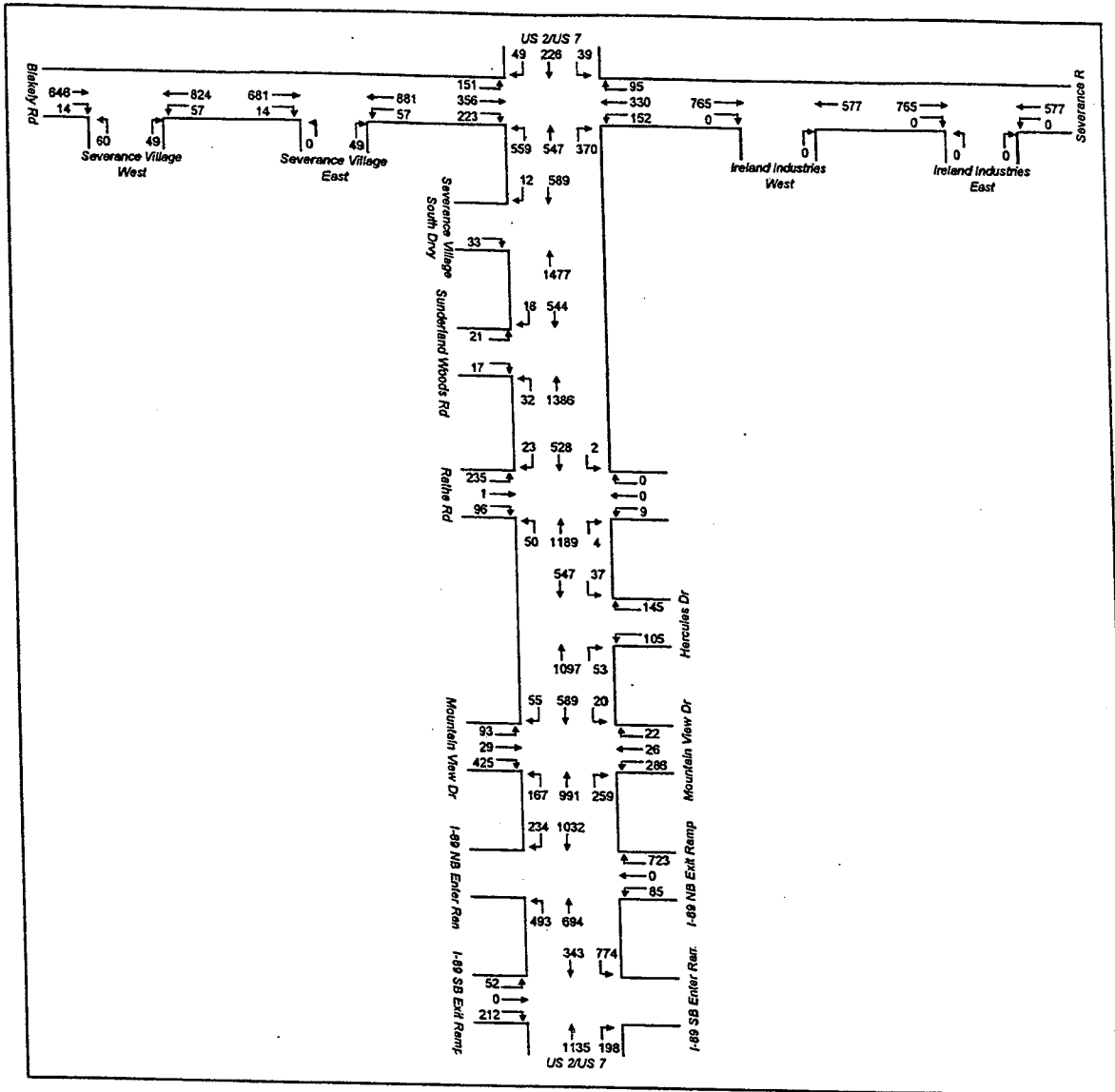
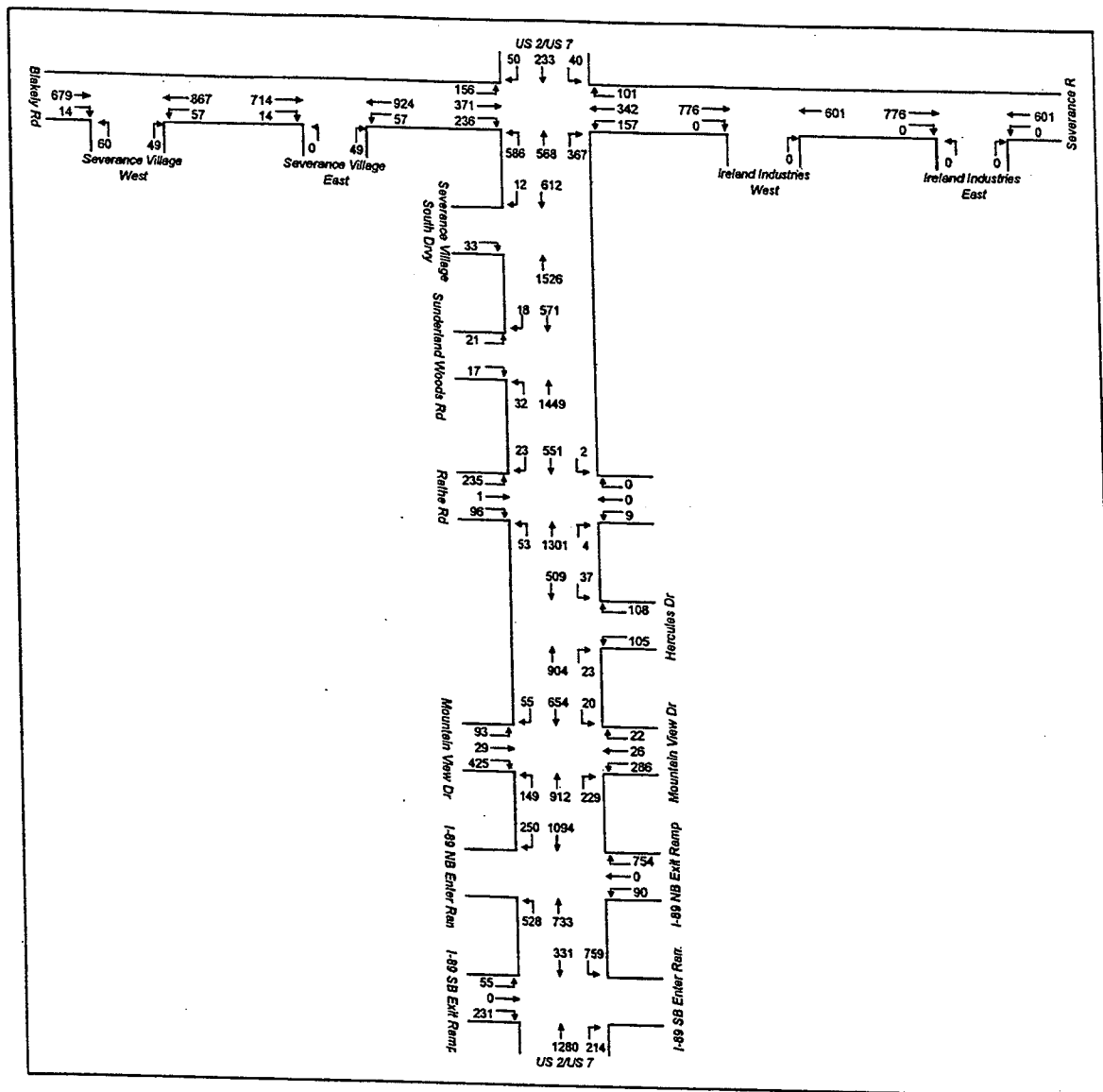


Figure 5: 2007 PM No Build Traffic Volumes



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Figure 7: 2012 PM No-Build Traffic Volumes



4.4 TRIP GENERATION OF THE PROPOSED PROJECT

Trip generation refers to the number of vehicles entering and exiting the site. The proposed development involves the construction of office space, retail space, a restaurant, day-care, and apartments/condominiums. National rates published in the Institute of Transportation Engineers'



(ITE) *Trip Generation*¹ were used to estimate the number of vehicle trips generated by this development during the AM and PM peak hours.

Table 8 and Table 9 provide the trip generation estimates for the proposed development during the AM and PM peak hours of adjacent street traffic. The tables indicate the total number of vehicle trips generated, the number of vehicle trips which will remain internal to the development, the number of pass-by trips, and finally the number of primary trips.

Table 8: AM Peak Hour Trip Generation Estimate

ITE Code	ITE Name	Size	Total Trips		Internal Trips		External Trips		Rate	Passby Trips		Primary Trips	
			Enter	Exit	Enter	Exit	Enter	Exit		Enter	Exit	Enter	Exit
ITE Code 230	Residential												
ITE Code 230	Condominium/Townhouse	206 units	9	49	2	9	7	40	0%	0	0	7	40
ITE Code 565	Daycare Center	4050 sq ft	27	24	2	2	26	22	0%	0	0	26	22
ITE Code 710	General Office Building	34040 sq ft	70	10	12	2	58	8	0%	0	0	58	8
ITE Code 814	Specialty Retail Center	12400 sq ft	41	44	7	9	34	35	34%	12	12	22	23
ITE Code 932	High-Turnover (Sit-Down) Restaurant	4050 sq ft	24	22	4	5	20	18	43%	9	8	12	10
TOTAL			171	149	27	27	145	123		20	20	125	103

Table 9: PM Peak Hour Trip Generation Estimate

ITE Code	ITE Name	Size	Total Trips		Internal Trips		External Trips		Rate	Passby Trips		Primary Trips	
			Enter	Exit	Enter	Exit	Enter	Exit		Enter	Exit	Enter	Exit
ITE Code 230	Residential												
ITE Code 230	Condominium/Townhouse	206 units	51	28	16	8	35	20	0%	0	0	35	20
ITE Code 565	Daycare Center	4050 sq ft	25	28	5	2	21	26	0%	0	0	21	26
ITE Code 710	General Office Building	34040 sq ft	20	97	6	23	14	74	0%	0	0	14	74
ITE Code 814	Specialty Retail Center	12400 sq ft	23	29	7	7	16	22	34%	5	7	10	14
ITE Code 932	High-Turnover (Sit-Down) Restaurant	4050 sq ft	27	17	8	4	19	13	43%	8	6	11	7
TOTAL			145	198	42	42	103	155		13	13	90	142

Total trips are estimated by multiplying a trip generation rate by the size of a specific land use. For the land uses in the proposed Ireland development, the number of households and square footages of the office, retail, and day care buildings were used as the independent variables.

Because this proposal co-locates housing, offices, and retail, a reduction in vehicle trips has been used in this analysis to account for internal trips. The number of internal trips was estimated using the Institute of Transportation Engineers' procedure for estimating the internal capture of trips due to mixed-use developments. These internal trips are subtracted from the total trips to estimate the number of external trips.

External trips consist of vehicles entering and exiting the site at the site driveways, including pass-by trips. Pass-by trips represent those that presently use highways that pass by the site and thus would not affect background traffic volumes, except to create turning movements to and from the site at the site's driveways. Pass-by trips are only associated with the retail and restaurant uses, as indicated in Table 8 and Table 9. ITE *Trip Generation* specified the average rates used in this analysis for the land uses of Shopping Center and High-Turnover (sit-down) Restaurants. The Shopping Center land use, though different in composition, reflects similar usage patterns as Specialty Retail.

¹ Institute of Transportation Engineers, *Trip Generation Handbook*, Seventh Edition, Washington DC, March 2001.



4.5 TRIP DISTRIBUTION OF THE PROPOSED PROJECT.

Figure 8 and Figure 9 show the distribution of vehicle trips from and to the Ireland development through the study intersections for all scenarios. Figure 10 and Figure 11 show the AM and PM 2007 Build Traffic Volumes. Figure 12 and Figure 13 show the AM and PM 2012 Build Traffic Volumes.

Figure 8: AM Peak Hour Trip Distribution

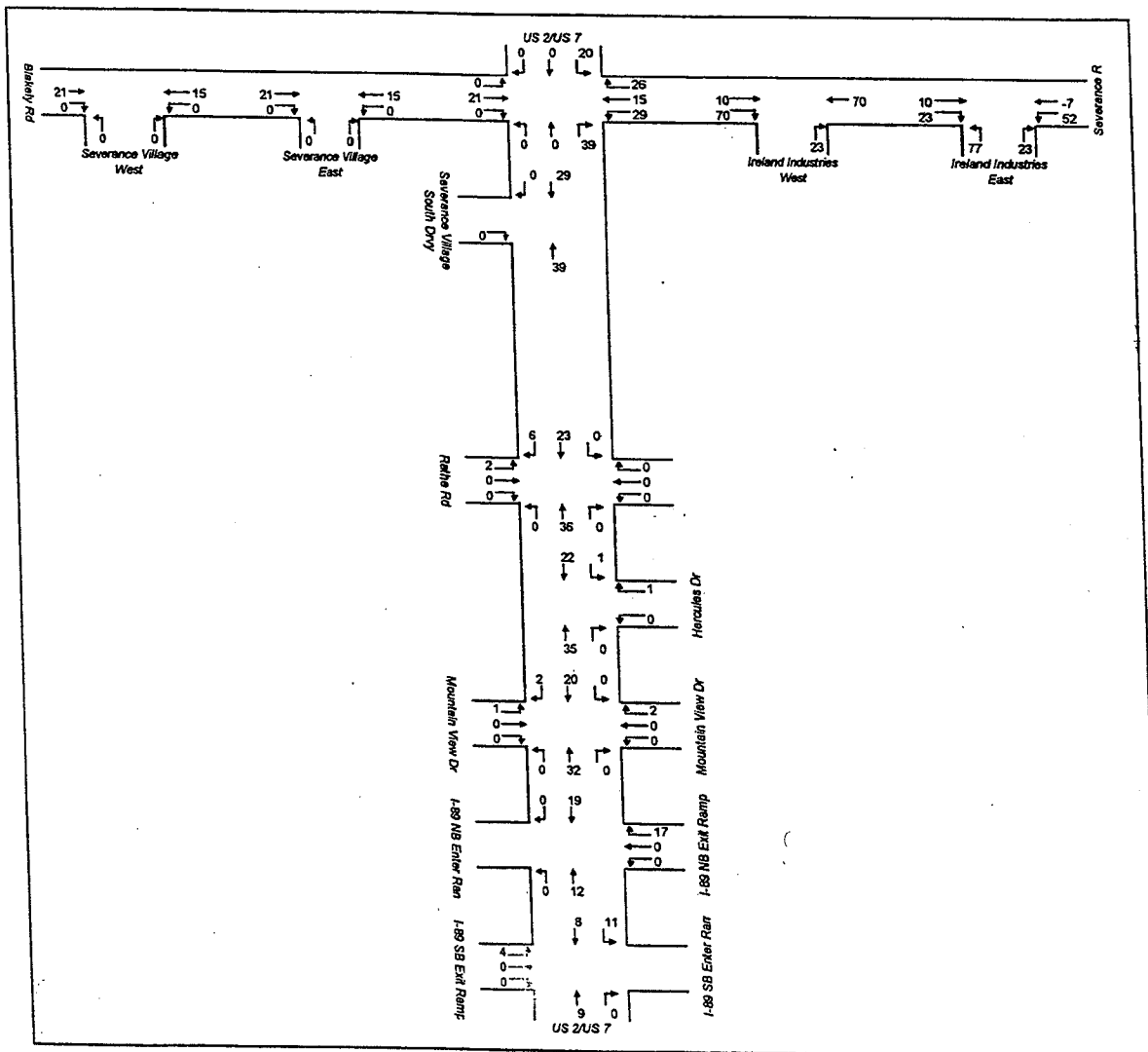
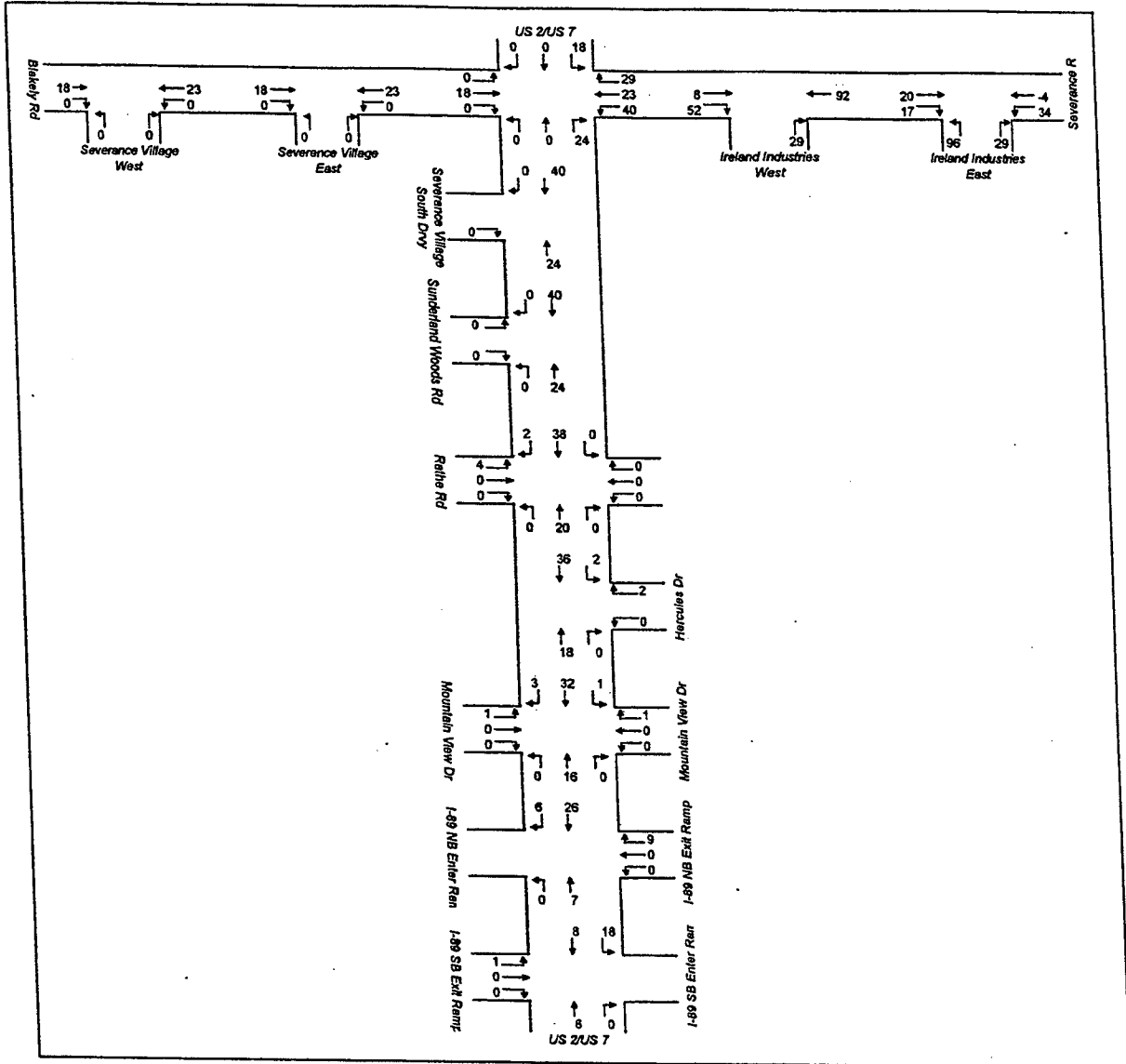


Figure 9: PM Peak Hour Trip Distribution



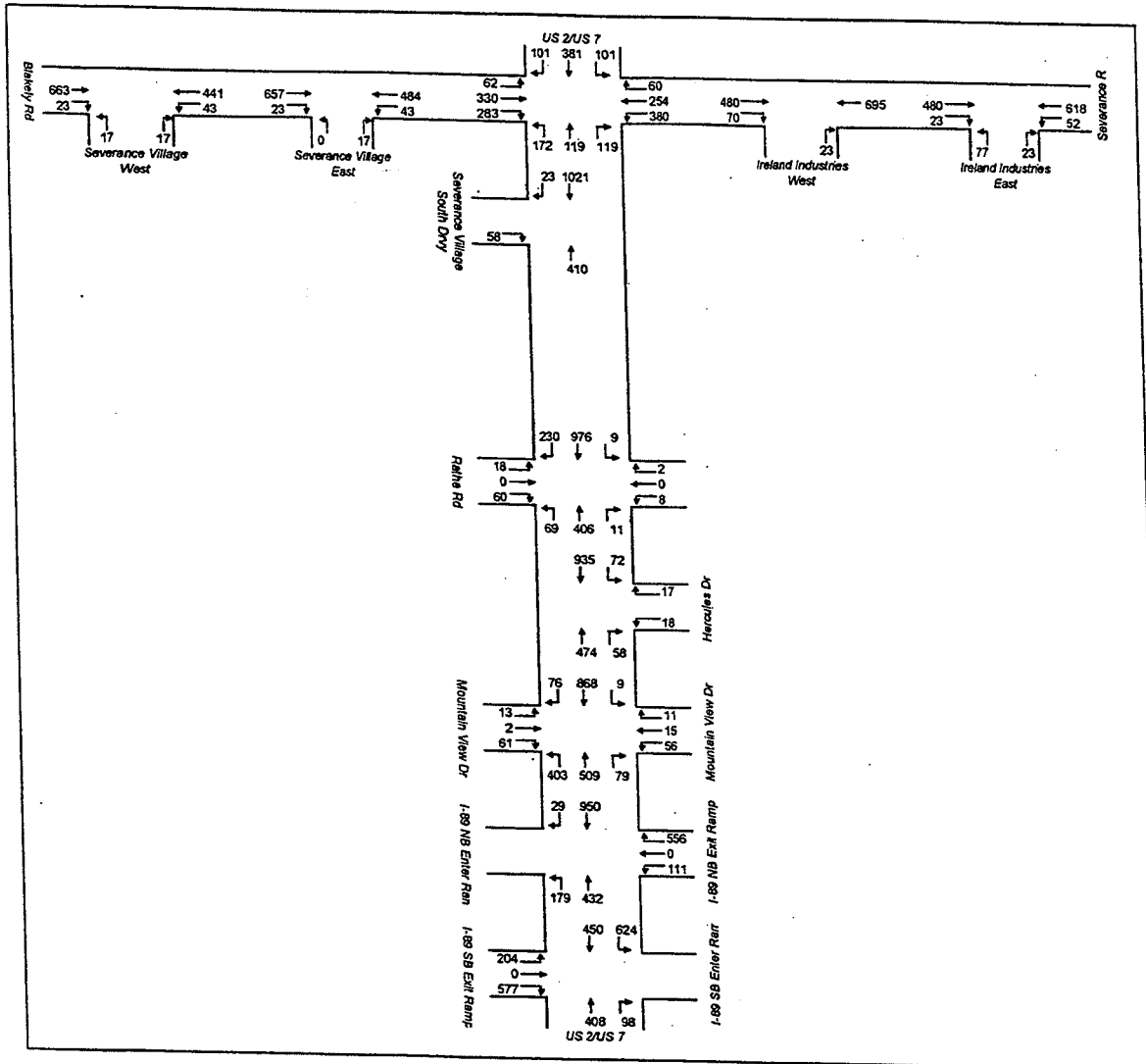


Figure 11: 2007 PM Build Traffic Volumes (No Build + Project Trip Traffic)

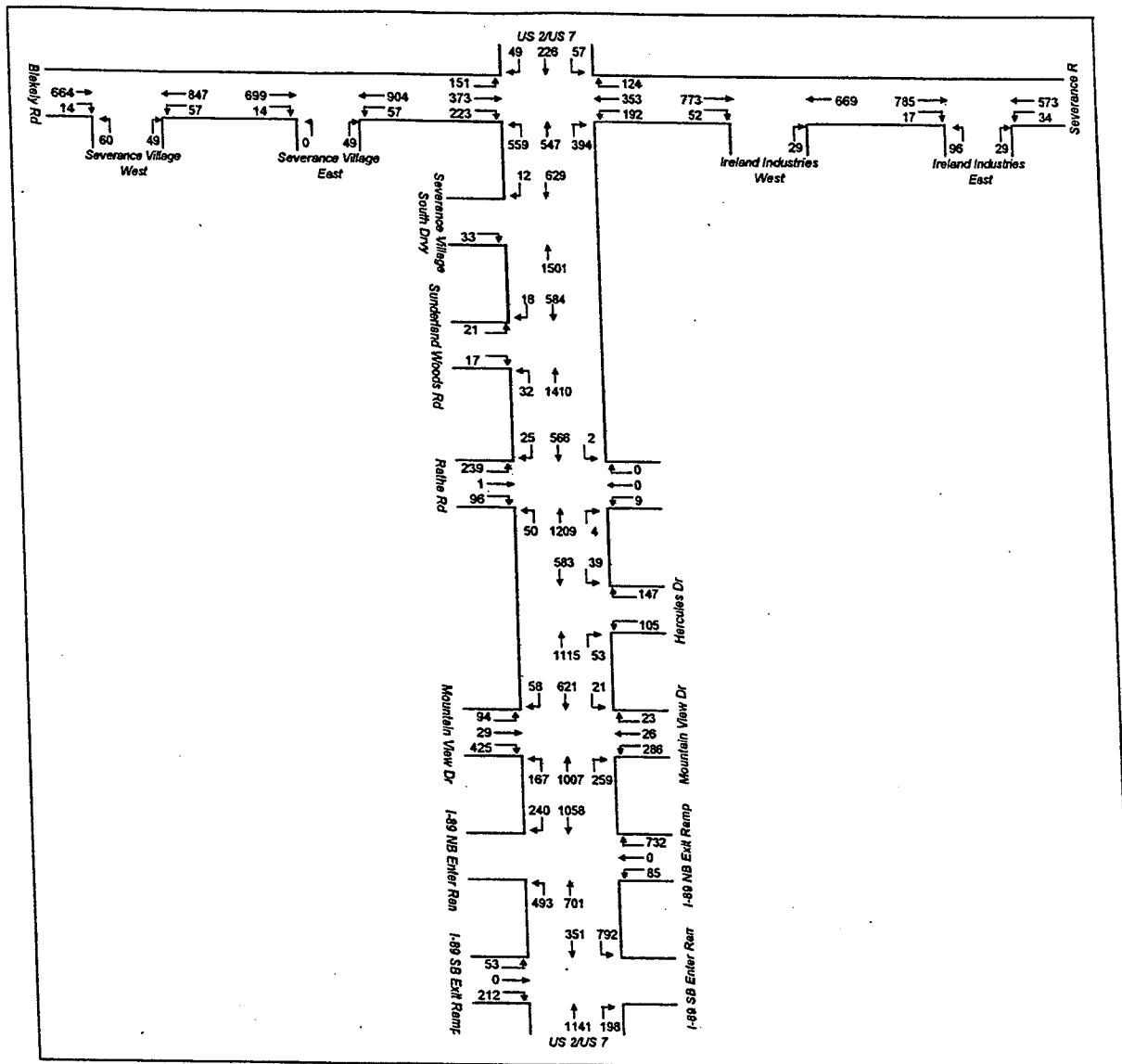


Figure 12: 2012 AM Build Traffic Volumes (No Build + Project Trip Traffic)

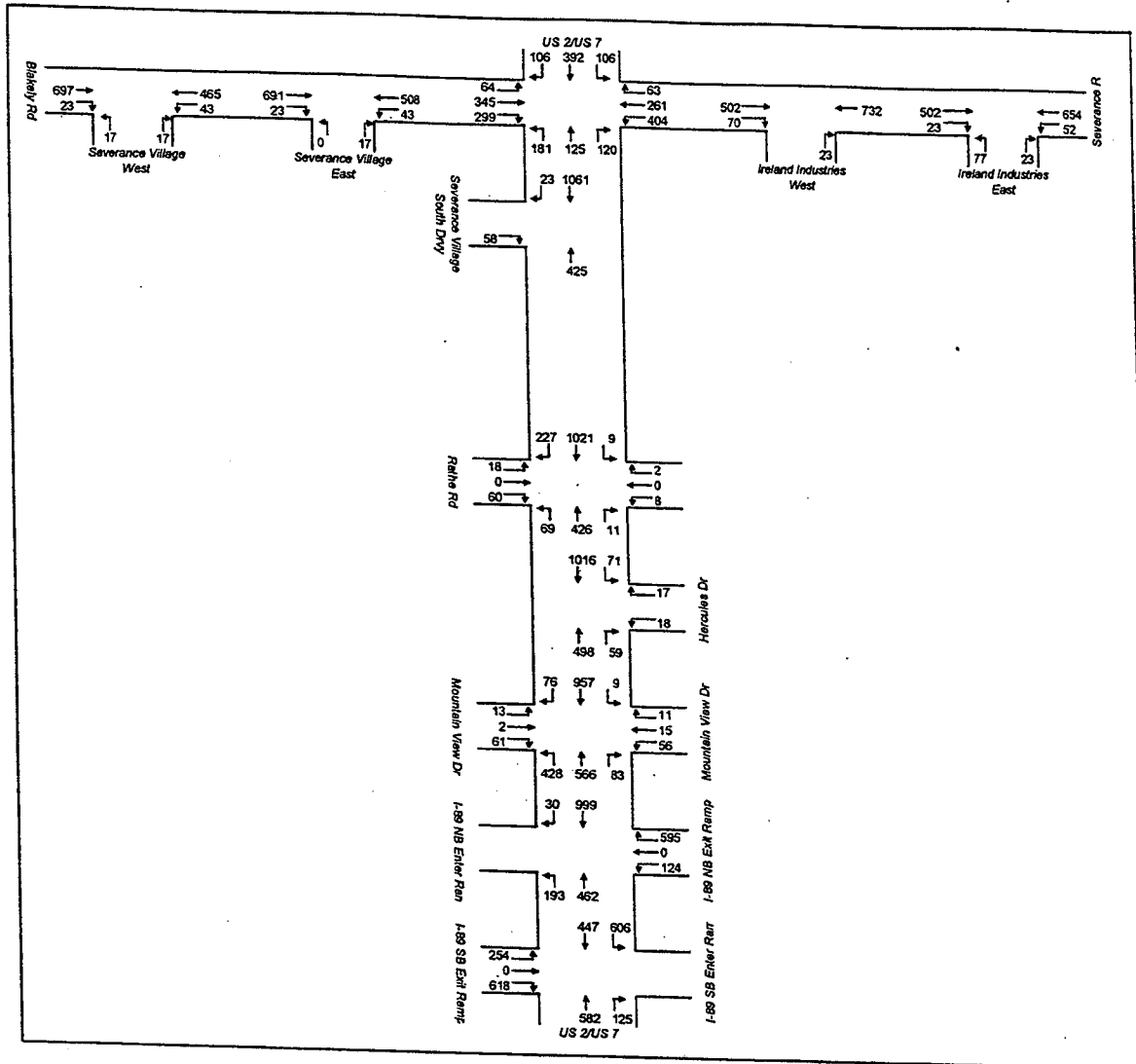
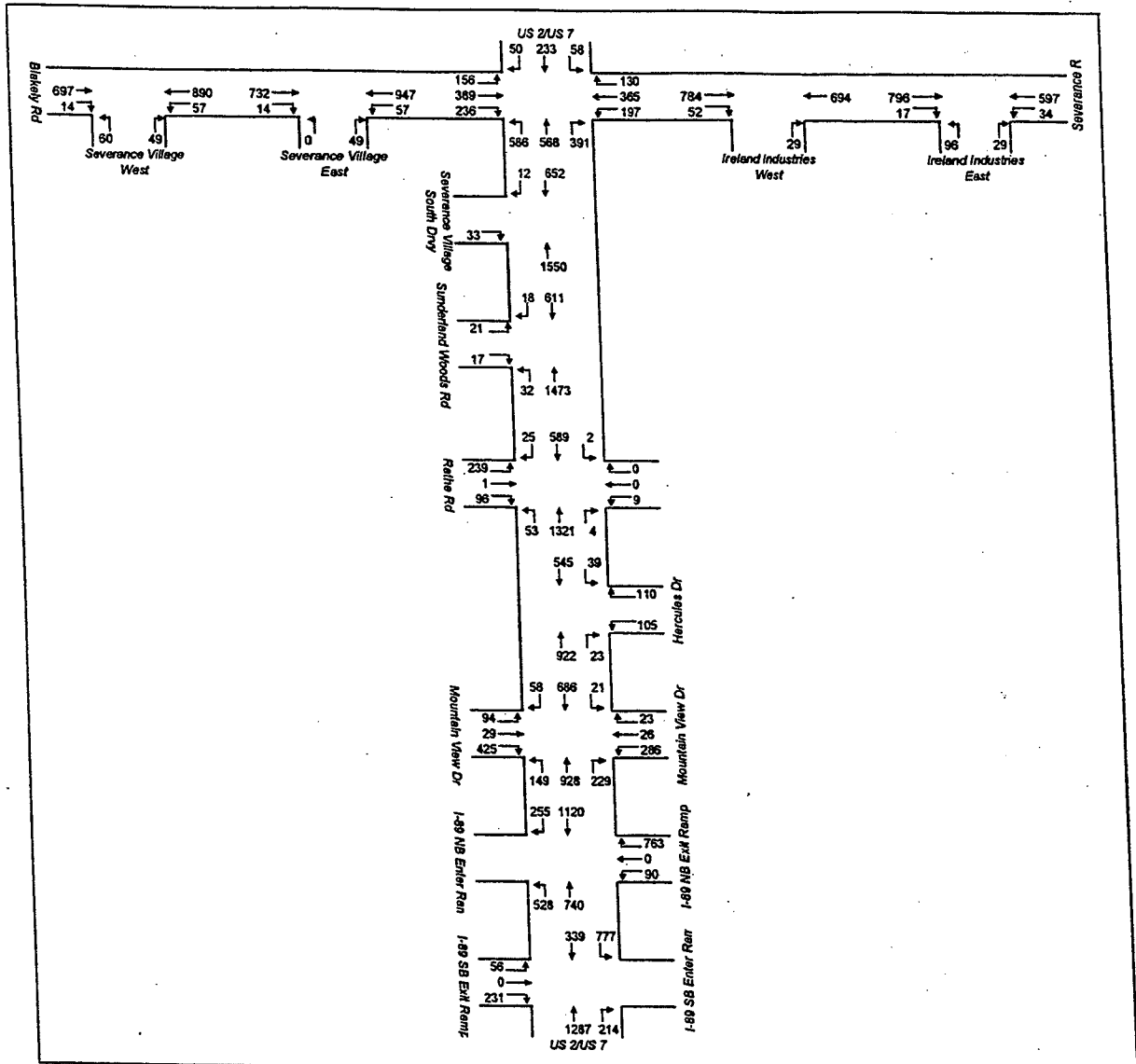


Figure 13: 2012 PM Build Traffic Volumes (No Build + Project Trip Traffic)



5.0 CONGESTION ANALYSIS

5.1 LEVEL OF SERVICE DEFINITION

Level-of-service (LOS) is a qualitative measure describing the operating conditions as perceived by motorists driving in a traffic stream. The 2000 Highway Capacity Manual defines six qualitative grades to describe the level of service at an intersection. Level-of-Service is based on the average



control delay per vehicle. Table 10 shows the various LOS grades and descriptions for signalized and unsignalized intersections.

Level-of-service is estimated using the procedures outlined in the 2000 Highway Capacity Manual. In addition to traffic volumes, key inputs include the number of left, through, and right turn lanes at each intersection and the traffic signal timing plans. The LOS results assume that the traffic signal timing plans have been optimized.

Table 10: Level-of-Service Criteria for Signalized and Unsignalized Intersections

LOS	CHARACTERISTICS	SIGNALIZED DELAY (sec)	UNSIGNALIZED DELAY (sec)
A	Little or no delay	< 10.0	< 10.0
B	Short delays	10.1-20.0	10.1-15.0
C	Average delays	20.1-35.0	15.1-25.0
D	Long delays	35.1-55.0	25.1-35.0
E	Very long delays	55.1-80.0	35.1-50.0
F	Extreme delays	80.0<	50.1<

In addition to LOS and Delay, VTrans has recommended using Volume to Capacity (V/C) ratios when analyzing capacity at stop-controlled intersections. A V/C ratio less than 1.0 indicates that adequate capacity is available on a specific approach.

5.2 LEVEL OF SERVICE RESULTS

Table 11 and Table 12 present the LOS results for the signalized and stop-controlled study intersections during the AM peak hour respectively. Table 13 and Table 14 present the LOS results for the signalized and stop-controlled study intersections during the PM peak hour respectively. Observations regarding the effect of the proposed development on LOS include the following:

- The proposed development does not cause a significant change in LOS at any of the study intersections during the 2007 and 2012 AM peak hours (See Table 11). V/C ratios at the stop-controlled intersection all remain less than 1.0 with and without traffic from the proposed project (See Table 12).
- Any noticeable impact of proposed Ireland development during the PM Peak Hour is limited to the US 2/7 intersection with Blakely and Severance Roads.
 - During the 2007 Build scenario, LOS drops from D to E on the westbound Severance Road approach due to traffic from the proposed project. This impact can be mitigated by optimizing the traffic signal timing. With traffic signal timing optimization the LOS remains at D under the Build scenario
 - During the 2012 Build scenario, LOS is projected to decrease from D to E on the westbound Severance Road approach. Under the 2012 No-Build scenario, the LOS is D with an average delay of 55 seconds/vehicle. This delay is just under the LOS D to E threshold of 55.1 seconds/vehicle. The LOS is projected to change to E with an average



delay of 72 seconds/vehicle under the 2012 Build-Scenario if no modifications are assumed to the traffic signal timing. Assuming an optimized traffic signal timing plan, the LOS remains at D with average delay/vehicle of 50 seconds, five seconds better than No-Build conditions. Therefore, optimizing the traffic signal timing mitigates the impact of the project on the westbound Severance Road approach to US 2/7.

- During all 2012 No-Build and Build scenarios, the US 2/7 southbound approach of US 2/7 to Severance/Blakely Road is projected to operate at LOS E. However, with traffic signal optimization, the average delay per vehicle is projected to decrease even when traffic from the proposed development is included.
- Because of its location near the four-way intersection of an arterial highway (US 2/7) and major collector roads (Severance Road and Blakely Road), traffic to and from the Ireland development is quickly divided and dispersed. As a result, the impact of the Ireland development along US 2/7 south of its intersection with Severance and Blakeley Roads is minimized and negligible in the study area.
- The levels of service for vehicles turning left from the proposed east driveway of the Ireland development are projected to operate at LOS F under the 2007 and 2012 PM peak hour scenarios. For unsignalized intersections, VTrans considers the volume to capacity ratio a better estimate of operating conditions on stop-controlled approaches with a poor level of service. LOS F is acceptable for a side street when the volume to capacity ratio is less than 1.00. The volume to capacity ratio ranges from 0.68 to 0.71 for the left turn from the Ireland East driveway to Severance Road and is therefore acceptable.
- Table 14 shows a projected LOS of F and V/C ratio greater than 1.0 for the west most entrance on Blakely Road to the Severance Corners Village Center during the 2007 and 2012 No-Build and Build PM peak hour scenarios. As noted in the final traffic study for that project, the final plat approval from the town of Colchester requires that a signal warrant analysis be conducted after Phase 1 of the Severance Road Village Center is completed and prior to issuance of a building permit for the fifth building. Table 15 presents the projected LOS during the 2012 PM peak hour for the No-Build and Build Scenarios assuming a traffic signal is installed at this intersection. With a traffic signal, LOS remains acceptable under the No-Build and Build scenarios.
- Level of Service F is projected at the stop-controlled Sunderland Woods approach to US 2/7 under all PM peak hour No-Build and Build scenarios. This LOS is caused by the large amount of through traffic on US 2/7 and is not attributable to the Ireland Industries' project.



Table 11: AM Peak Hour LOS Results for Signalized Study Intersections

Intersection	2007 No Build		2007 Build		2012 No Build		2012 Build	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
US 7 - Blakely Road - Severance Road								
Overall	D	37	D	39	D	38	D	42
WB, exiting Severance Road	C	27	C	33	D	40	D	47
EB, exiting Blakely Road	C	34	D	37	D	45	D	51
NB, along US 7	C	21	C	21	C	24	C	24
SB, along US 7	E	61	E	60	D	36	D	37
US 7 - Rathe Road								
Overall	A	4	A	4	A	4	A	4
EB, exiting Rathe Road	C	30	C	33	C	33	C	33
WB, exiting Champlain Drive	C	30	C	33	C	33	C	33
NB, along US 7	A	2	A	1	A	1	A	1
SB, along US 7	A	3	A	2	A	2	A	2
US 7 - Hercules Drive								
Overall	A	3	A	2	A	2	A	2
WB, exiting Hercules Drive	C	31	C	34	C	34	C	34
NB, along US 7	A	1.0	A	0.5	A	0.5	A	0.5
SB, along US 7	A	3	A	2	A	2	A	2
US 7 - Mountain View Drive								
Overall	B	13	B	14	B	15	B	15
WB, exiting Lower Mountain View Drive	C	32	C	33	C	33	C	33
EB, exiting Mountain View Drive	B	17	B	17	B	16	B	16
NB, along US 7	B	13	B	11	B	11	B	11
SB, along US 7	B	12	B	16	B	18	B	18
US 7 - I89 Northbound Ramps								
Overall	B	12	B	13	B	13	B	13
WB, exiting I89 Northbound Ramps	C	27	C	30	C	29	C	29
NB, along US 7	A	8	A	8	A	7	A	7
SB, along US 7	A	5	A	4	A	5	A	5
US 7 - I89 Southbound Ramps								
Overall	B	19	B	20	C	22	C	23
EB, exiting I89 Southbound Ramps	C	26	C	29	C	30	C	31
NB, along US 7	C	28	C	29	C	35	D	35
SB, along US 7	A	9	A	9	A	7	A	8

Table 12: AM Peak Hour LOS Results for Unsignalized Study Intersections

Intersection	2007 No Build			2007 Build			2012 No Build			2012 Build		
	LOS	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay
Severance Road - Ireland Industries East												
WB left, entering development	-	-	-	A	0.05	9	-	-	-	A	0.05	9
NB left, exiting development towards US 7	-	-	-	E	0.40	36	-	-	-	E	0.44	41
NB right, exiting development towards Mill Pond Rd	-	-	-	B	0.04	12	-	-	-	B	0.04	12
Severance Road - Ireland Industries West												
NB right, exiting development	-	-	-	B	0.04	12	-	-	-	B	0.04	12
Blakely Road - Severance Vill. East												
WB left, entering Severance Vill. development	A	0.05	9	A	0.05	9	A	0.05	9	A	0.05	9
NB right, exiting development towards US 7	B	0.04	13	B	0.04	13	B	0.04	13	B	0.04	14
Blakely Road - Severance Vill. West												
WB left, entering Severance Vill. development	A	0.05	9	A	0.05	9	A	0.05	9	A	0.05	9
NB left, exiting development towards Malletts Bay	C	0.08	24	D	0.09	25	D	0.09	27	D	0.10	28
NB right, exiting development towards US 7	B	0.04	13	B	0.04	13	B	0.04	13	B	0.04	14
US 7 - Severance Vill. South												
EB right, exiting Severance Vill. development	E	0.34	36	E	0.4	41	E	0.38	42	E	0.42	49



6.0 SAFETY ANALYSIS

6.1 SIGHT DISTANCES

Table 16 compares the required stopping sight distance and corner sight distances to the available sight distances observed in the field. The required sight distances are provided in the Vermont State Standards for collector roads. The design speed on Severance Road is assumed to be five miles per hour greater than the posted speed of 35 miles per hour. Based on observations made in the field, there is a clear line of sight between US 7 and each of the proposed driveways along a flat, straight section of Severance Road. From the east, there is a clear line of sight between Pheasant Woods and each of the proposed east and west driveways. The available sight distances presented in Table 16 are based on these observations.

Table 16: Sight Distance Assessment Along Severance Road at Proposed East and West Entrance Roads

	Vermont State Design Standards for Collector Road with 40 mph Design Speed	Available at East Driveway	Available at West Driveway
Eastbound Stopping Sight Distance	275 feet	2100 feet	1680 feet
Westbound Stopping Sight Distance	275 feet	790 feet	1270 feet
Corner Sight Distance to the West	440 feet	2100 feet	1680 feet
Corner Sight Distance to the East	440 feet	790 feet	1270 feet

The sight distances in both directions meet the design standards for the provision of safe access.

6.2 CRASH DATA

VTrans maintains a crash reporting system, which is a statewide database of all reported crashes.¹ A reportable crash is a collision or crash with at least one of the following results caused by the event: property damage exceeding \$1,000, personal injury, or fatality.

Crash histories were collected from the VTrans (1998 to 2002) at each of the study intersections and road segments along US 2/7 from I-89 Exit 16 to Poor Farm Road, Severance Road from US 2/7 to Mill Pond Road, and Blakely Road from US 2/7 to Poor Farm Road. The complete list of crashes is contained in Appendix C. In order to be classified as a High Crash Location (HCL), an intersection or road section (0.3 mile section) must meet two conditions: 1) it must have at least 5 crashes per year over a 5-year period; and 2) the Actual Crash rate must exceed the Critical Crash Rate.

The one High Crash Location identified in the study area is the intersection of US 2/7 with Blakely and Severance Roads. This intersection was the subject of a study by the Chittenden County MPO

¹ This data is exempt from Discovery or Admission under 23 U.S.C. 409.

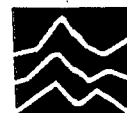


Table 13: PM Peak Hour LOS Results for Signalized Study Intersections

Intersection	2007 No Build		2007 Build		2007 Build Mit*		2012 No Build		2012 Build		2012 Build Mit*	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
US 7 - Blakely Road - Severance Road												
Overall	D	38	D	43	D	41	D	40	D	45	D	44
WB, exiting Severance Road	D	53	E	66	D	52	D	55	E	72	D	50
EB, exiting Blakely Road	D	38	D	38	D	36	D	39	D	39	D	36
NB, along US 7	C	29	C	32	D	38	C	31	C	34	D	44
SB, along US 7	D	55	D	54	D	46	E	57	E	55	E	55
US 7 - Rathe Road												
Overall	D	45	D	46	B	17	C	22	C	24	C	23
EB, exiting Rathe Road	F	254	F	264	D	48	E	60	E	64	E	66
WB, exiting Champlain Drive	D	40	D	40	C	27	C	27	C	27	C	30
NB, along US 7	A	8	A	9	B	14	C	21	C	23	C	21
SB, along US 7	A	2	A	2	A	4	A	4	A	4	A	4
US 7 - Hercules Drive												
Overall	A	7	A	6	A	6	A	6	A	6	A	6
WB, exiting Hercules Drive	D	39	D	39	C	32	C	30	C	30	C	33
NB, along US 7	A	1	A	1	A	2	A	2	A	2	A	1
SB, along US 7	A	3	A	3	A	3	A	3	A	3	A	3
US 7 - Mountain View Drive												
Overall	B	18	B	18	B	18	B	17	B	17	B	18
WB, exiting Lower Mountain View Drive	D	43	D	43	D	38	C	35	C	35	D	39
EB, exiting Mountain View Drive	C	23	C	23	B	20	B	18	B	18	C	21
NB, along US 7	B	12	B	12	B	16	B	14	B	14	B	14
SB, along US 7	B	15	B	15	B	12	B	12	B	12	B	13
US 7 - 189 Northbound Ramps												
Overall	B	19	B	20	B	18	B	17	B	18	B	20
WB, exiting 189 Northbound Ramps	D	41	D	41	C	34	C	33	C	34	D	38
NB, along US 7	A	3	A	2	A	5	A	3	A	3	A	5
SB, along US 7	C	21	C	23	B	20	C	20	C	21	C	22
US 7 - 189 Southbound Ramps												
Overall	C	32	C	31	C	31	C	34	D	36	C	33
EB, exiting 189 Southbound Ramps	D	41	D	42	C	34	C	31	C	31	D	37
NB, along US 7	C	28	C	29	D	39	D	38	D	39	D	36
SB, along US 7	C	33	C	31	C	20	C	29	C	33	C	28

* Assumes signal timing is optimized after the project has been built

Table 14: PM Peak Hour LOS Results for Unsignalized Study Intersections

Intersection	2007 No Build			2007 Build			2012 No Build			2012 Build		
	LOS	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay
Severance Road - Ireland Industries East												
WB left, entering development	-	-	-	A	0.04	10	-	-	-	A	0.04	10
NB left, exiting development towards US 7	-	-	-	F	0.68	72	-	-	-	F	0.71	80
NB right, exiting development towards Mill Pond Rd	-	-	-	C	0.07	15	-	-	-	C	0.08	15
Severance Road - Ireland Industries West												
NB right, exiting development	-	-	-	C	0.08	15	-	-	-	C	0.08	15
Blakely Road - Severance Vill. East												
WB left, entering Severance Vill. development	A	0.06	9	A	0.06	9	A	0.07	9	A	0.07	10
NB right, exiting development towards US 7	B	0.11	14	B	0.11	14	B	0.11	15	B	0.12	15
Blakely Road - Severance Vill. West												
WB left, entering Severance Vill. development	A	0.06	9	A	0.06	9	A	0.06	9	A	0.06	9
NB left, exiting development towards Malletts Bay	F	1.32	387	F	1.62	543	F	1.82	650	F	2.32	923
NB right, exiting development towards US 7	B	0.10	14	B	0.11	14	B	0.11	14	B	0.11	14
US 7 - Severance Vill. South												
EB right, exiting Severance Vill. development	B	0.07	13	B	0.4	14	B	0.07	14	B	0.08	15
US 7 - Sunderland Woods												
EB left-right, exiting Sunderland Woods Road	F	>10		F	>10		F	>10		F	>10	
NB left, entering Sunderland Woods Rd from US 7	A	0.03	9	A	0.03	9	A	0.03	9	A	0.03	9

Table 15: 2012 PM Peak Hour LOS at Blakely Road-West Drive to Severance Village with Traffic Signal

Intersection	2012 No-Build		2012 Build	
	LOS	Delay	LOS	Delay
Blakely Road - Severance Vill. West				
Overall	A	6	A	6
EB, Blakely Road	A	4	A	5
WB left, entering Severance Vill. development	A	3	A	3
WB thru, Blakely Road	A	6	A	7
NB left, exiting development towards Malletts Bay	B	15	B	16
NB right, exiting development towards US 7	B	15	B	15





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MEMORANDUM

To: Bryan Osborne, Colchester Public Works Director
From: Joe Segale, P.E.
Subject: Ireland Industries Traffic Impact Study – US7/Severance Road Safety Analysis Update
Date: 7 December 2005
Cc: Mike Coates, Ireland Industries; Mike Buscher, T.J. Boyle Associates

This memorandum responds to your question regarding the safety analysis presented in the August 31, 2005 traffic impact study prepared by RSG for the Ireland Industries Severance Corners Mixed Use Development.

The study points out that the intersection of US 7-Severance Road-Blakely Road is identified by the Vermont Agency of Transportation (VTrans) as a High Crash Location (HCL) based on 1998-2002 crash records. The study then explains that (1) it is unlikely that the intersection is still an HCL because modifications were made in 2001 to address safety concerns; (2) the modifications made were effective at addressing the safety concerns; and (3) the proposed development will not add traffic to predominant movements involved in crashes.

The Town asked that these points be verified with crash data provided by the Colchester Police Department between 2002 and the end of November 2005. It is logical to start with crash records in 2002 because that is the first entire year after the modifications were made.

Is the Intersection a High Crash Location based on 2002-2005 data?

For an intersection to be designated as a high crash location, it must meet the following two conditions: (1) it must have at least five crashes per year over a five year period, and (2) the actual crash rate at the intersection must exceed a critical crash rate.

The actual crash rate (number of crashes per million vehicles passing through the intersection) is based on the number of reportable crashes divided by the traffic passing through the intersection. Reportable crashes are those that result in more than \$1,000 in property damage, involve and injury, or cause a fatality. Table 1 summarizes the total and reportable crashes for the intersection. A detailed list of the crashes is contained in Attachment A.

Table 1: Summary of Crashes 2002 through November 2005 – US 7/Severance Road/Blakely Road

Year	All Crashes	Reportable Crashes	Injuries	Fatalities
2002	4	4	3	0
2003	7	4	1	0
2004	9	8	2	0
2005	9	6	2	0
	29	22	8	0

The critical crash rate is calculated by adjusting a statewide average crash rate that varies by highway functional class and whether or not the intersection is located in an urban or rural area. When VTrans identified the US 7-Severance Road-Blakely Road intersection as an HCL, their analysis assumed the intersection is located in a rural area. Although US 7 and Severance Road are officially designated as urban principal and urban minor arterials respectively, this updated analysis continues to assume both roadways are rural¹.

The actual to critical ratio is 0.95 indicating that the intersection no longer satisfies the high crash location criteria. The actual crash rate has decreased slightly from 0.846 based on 1998-2002 data to 0.810 based on 2002-2005 data. Attachment B shows how the actual/critical ratio was calculated.

Were the modification made effective at addressing the safety concerns?

The predominant crash type identified in the 1999 study completed by Dubois and King for the CCMPO were conflicts between northbound vehicles turning left and southbound vehicles traveling through. To address this type of crash, protected left turn phases were added to the northbound and southbound approaches. Additional turn lanes were added to the Blakely Road and US 7 northbound approaches as well to increase the capacity of the intersection, to provide exclusive left turn lanes on all four approaches, and to improve the overall alignment of travel lanes and visibility.

These modifications have been effective at reducing the conflicts between through and left-turning vehicles. Before the modifications were implemented, 43% of the crashes at the intersection occurred between left-turning and through vehicles. As indicated in Table 2, crashes between left-turning and through vehicles accounted for 14% of the crashes between 2002 and 2005. The modifications have also helped reduce the proportion of right-angle broadside crashes from 46% to 3%.²

¹ If VTrans had analyzed the intersection as an urban facility, the intersection would not have been identified as a high crash location.

² "Before" crash percentages in this paragraph are based on data presented in the April 4, 1999 Memorandum Prepared by Dubois & King for the CCMPO.



Rear-end crashes are now the predominant crash type at the intersection. Rear-end crashes account for 62% of all crashes at the intersection. Most of these rear-end crashes occurred on the US 7 northbound and southbound approaches. Many of these crashes occurred while vehicles were stopped at the light or shortly after the light turned green. A review of the causes for crashes does not reveal any specific pattern, however inattention, leaving before the light turns green, or assuming that the left-turn arrow means through traffic can go can all be attributed to driver error rather than a problem with the operation of the traffic signal.

The decrease in left-through and right-angle broadside crashes, and increase in rear-end collisions, has resulted in an overall decrease in the number of injuries that have occurred at the intersection. There were 22 injuries reported between 1998 and 2002 and 8 reported between 2002 and 1998. The injury rate has been cut in half from 0.64 to 0.30 injuries per million vehicles¹. Rear-end collisions at this intersection were made at slower speeds because they often occurred while vehicles were stopped at the traffic signal or just after vehicles began to travel through the intersection. Therefore, crashes have been less severe since the modifications were made resulting in less injuries.

Will the proposed development add traffic to the predominant crash type?

- Three of the seven rear-end crashes that occurred on the US 7 northbound approach were located in the left or through lane and one occurred in the right-turn lane. The specific lane for the remaining three crashes is not specified. Traffic added from the Ireland development will be limited to the US 7 northbound right-turn lane. Because the data suggest that rear-end collisions are not a significant problem for the right-turn lane, the Ireland development will not affect the safety on this approach.
- Rear-end crashes are also predominant on the US 7 southbound approach. The Ireland development will add traffic to the left turn lane on that approach. The crash records did not specify on which lanes the crashes occurred, nor did they suggest rear-ends are limited to the left-turn lane. An advisory speed limit of 40 miles per hour is posted on two warning signs located on the southbound approach. These warning signs provide sufficient notification to drivers of the upcoming intersection. As the Severance Corners areas develops, and becomes more urban the speed limit on US 7 should be reduced to 35 miles per hour. This speed reduction may help reduce some of the rear-end crashes at the intersection by providing more reaction time for drivers.

¹ The injury rate provides a direct comparison between the 5 year period from 1998 to 2002 and the 4 year period from 2002 to 2005.



- The Ireland development will have its greatest effect on the Severance Road westbound approach. Two crashes occurred on that approach between 2002 and 2005 and were each caused by the failure of drivers to obey the traffic signals. One crash occurred on the eastbound Blakely Road approach and was also caused by driver error that is not associated with the intersection's operation or configuration. Therefore, there are no crash patterns on the Severance Road and Blakely Road approaches that will be affected by the Ireland project.

Table 2: Crash Type Summary 2002-2005

Crash Type	Location	Number of Crashes	Percent of all intersection crashes	Number of Injuries	Fatalities
Left Turning - Opposite Direction	Northbound US 7	1	3%	0	0
	Southbound US 7	1	3%	2	0
	Eastbound Blakely Road	0	0%	0	0
	Westbound Severance Road	2	7%	0	0
	<i>Crash Type Total</i>	4	14%	2	0
Right Angle Broadside	Northbound US 7	0	0%	0	0
	Southbound US 7	1	3%	0	0
	Eastbound Blakely Road	0	0%	0	0
	Westbound Severance Road	0	0%	0	0
	<i>Crash Type Total</i>	1	3%	0	0
Rear-end	Northbound US 7	7	24%	4	0
	Southbound US 7	7	24%	0	0
	Eastbound Blakely Road	1	3%	1	0
	Westbound Severance Road	0	0%	0	0
	Northbound, just north of Severance Rd	2	7%	1	0
	Westbound Blakely, just west of US 7	1	3%	0	0
	<i>Crash Type Total</i>	18	62%	6	0
Sideswipe	Southbound US 7	1	3%	0	0
	<i>Crash Type Total</i>	1	3%	0	0
Other	Hit deer or moose	4	14%		
	Unknown	1	3%		
<i>Total Intersection</i>		29	100%	8	0

SUMMARY

This memorandum presents an analysis of crash records from 2002 through November 2005 at the US 7-Severance Road-Blakely Road intersection. Modifications were made at the intersection in 2001 to address safety concerns related to conflicts between northbound vehicles turning left and



southbound vehicles traveling through. To address this type of crash, protected left turn phases were added to the northbound and southbound approaches. Turn lanes were also added so that all approaches now have an exclusive left-turn lane. The following findings are based on the analysis above:

- The crash rate decreased slightly between the 1998-2002 and 2002-2005 periods and the intersection is no longer a high crash location.
- The modifications made in 2001 have been effective at significantly reducing crashes between left-turning and through vehicles and right-angle broadsides.
- Rear-end crashes have increased significantly. These crashes are less severe and the injury rate has been cut in half from 0.64 to 0.30 injuries per million vehicles.
- The Ireland Industries project will not exacerbate the number of rear-end collisions occurring at the intersection.
- The Severance Corners intersection is located in an emerging urban/suburban area. As the surrounding area develops the speed limit on US 7 should be decreased, to perhaps 35 miles per hour, to better reflect the area through which it is passing. This speed reduction will improve the safety of the intersection by allowing drivers more time to react to changes in the roadway and decreasing the severity of crashes.

The safety improvement at the intersection can be attributed to providing protected-left turn phasing and the inclusion of exclusive left-turn lanes on all of the approaches. The level of service analyses on which the August 31, 2005 traffic impact study is based, assumed the protected left-turn phases would be provided for the planning year. Therefore, no additional mitigation for safety reasons are recommended.



7 December 2005

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Attachment A

US 7-Severance Road-Blakely Road Crashes January 2002-November 30, 2005

Crash ID Code	Date	Time	PDO > \$1,000	Injuries	Fatalities	Location/Direction of Travel	Crash Type	Cause and other Notes	Assumed Reportable
02cc02491	5/24/2002	5:05 PM	Yes	3	0	US 7 NB	Rear-end	Inattention	Yes
02cc06807	12/18/2002	3:46 PM	Yes	0	0	US 7 SB	Rear-end		Yes
03cc05923	1/26/2003	5:09 PM	Yes	0	0	US 7 NB	Hit deer - single car		No
04cc03224	6/5/2004	4:10 AM	Yes	0	0	?	Hit moose - single car		No
05cc06968	10/21/2005	1:08 PM	Yes	0	0	Severance RD WB	Left turning opposite dir	Failed to yield ROW	Yes
02cc03096	6/19/2002	9:19 AM	Yes	0	0	US 7 SB	Rear-end		Yes
02cc04722	8/27/2002	2:41 PM	Yes	0	0	US 7 NB	Rear-end	Driver confused left turn arrow for through movement	Yes
03cc00975	3/4/2003	2:46 PM	Yes	0	0	Severance RD WB	Left turning opposite dir	Failed to obey traffic signal	Yes
03cc01084	3/13/2003	7:54 AM	Yes	0	0	US 7 SB	Right Angle Broadside	Failure to yield ROW	Yes
03cc02212	5/20/2003	7:30 AM	No	0	0	US 7 SB	Rear-end	Inattention	No
03cc03897	8/2/2003	12:33 PM	Yes	0	0	US 7 NB	Rear-end	Inattention	Yes
03cc04621	9/16/2005	2:22 PM	Yes	0	0	US 7 NB	Rear-end	Sudden stop to allow SB through vehicle	Yes
03cc05581	11/6/2003	6:30 PM	?	0	0	?	Hit deer - single car		No
04cc03684	6/22/2004	2:30 PM	Yes	1	0	US 7 NB	Rear-end		Yes
04cc05637	9/8/2004	7:35 AM	Yes	0	0	US 7 SB	Rear-end	Attention diverted while avoiding cyclist	Yes
04cc06193	9/30/2004	7:36 AM	Yes	0	0	US 7 SB	Rear-end	Breaks failed	Yes
04cc06617	10/15/2004	6:30 PM	Yes	0	0	US 7 NB	Rear-end	Inattention	Yes
04cc06617	6/12/2005	1:45 PM	Yes	2	0	US 7 NB	Left turning opposite dir	Failed to yield ROW	Yes
04cc06703	10/20/2004	6:39 PM	Yes	0	0	US 7 SB	Left turning opposite dir	SB vehicles could not see NB left turning veh - blocked by truck	Yes
04cc06629	10/16/2004	10:53 AM	Yes	0	0	?	Unknown	Not enough information in report to determine type and cause	Yes
04cc08070	12/20/2004	9:10 AM	Yes	1	0	NB, just north of Severance Rd	Rear-end	Vehicle stopped suddenly when a snow plow turned into chiropractor office driveway	Yes
05cc00516	1/25/2005	10:27 PM	Yes	0	0	?	Hit deer - single car		No
05cc04366	3/12/2005	9:15 PM	Yes	0	0	US 7 SB	Rear-end	Driver left scene	Yes
05cc04460	7/15/2005	9:00 AM	No	0	0	US 7 SB	Rear-end	Inattention	No
05cc07085	10/27/2005	7:55 AM	No	0	0	NB, just north of Severance Rd	Rear-end	DWI, Vehicle stopped suddenly when a vehicle turned into chiropractor office driveway	No
02cc02320	5/16/2005	4:28 PM	Yes	0	0	US 7 SB	Sideswipe	Improper use of turn lane	Yes
03cc01583	7/15/2003	1:55 PM	No	1	0	Blakely EB	Rear-end	Started before light turned green	Yes
04cc00767	2/12/2004	1:16 PM	Yes	0	0	WB Blakely, just west of US 7	Rear-end	Front driver stopped suddenly	Yes
05cc02155	4/14/2005	3:44 PM	No	0	0	US 7 NB	Rear-end	Front driver stopped suddenly	Yes

Reportable Crashes	22
Not Reportable	7
Total	29



Attachment B: US 7-Severance Road-Blakely Road High Crash Calculation**1. Determine AADT through Intersection and Vehicle Exposure 2002-Nov 2005**

VTrans reported AADT = 18,786 in its 1998-2002 High Crash Location Report
 The table below determines AADT for each year 2002 through 2005
 at the study intersection.

Year	Station D040	US 7-Severance Road	
2002	14,200	18,786	Per VTrans HCL Report
2003	14,100	18,654	Estimated
2004	14,500	19,183	Estimated
2005	14,730	19,487	Estimated

Station D040 is located on US 7 south of Severance Road
 2005 AADT for D040 based on growth factors published in VTrans Red Book
 AADT at US 7-Severance assumed to grow at same rate as AADT at station D040

M - Vehicle Exposure at Intersection

M = 27.18 Million Vehicles Through Intersection
 Jan 2002 through Nov 30 2005

2. Calculate Actual Crash Rate

Reportable Crashes: 22

Crash Rate: 0.81 Crashes per million vehicles

3. Determine Critical Crash Rate

Average Statewide Crash Rate 0.538 for intersection of rural principal and minor arterials

Critical Crash Rate: 0.85 Crashes per million vehicles
 (Formula Per VTrans HCL Documentation)

4. Actual-to-Critical Ratio

Actual Rate	0.81
Critical Rate	0.85
Ratio	0.95 Not and HCL because it is less than 1.0



